Final Examination

Math 125 Kovitz Spring 2021

To get full credit you must show your work. No work, no credit.

Answer at least twelve questions. If you answer more than twelve questions, the best twelve will be counted. Each question is worth 7 1/2 points.

- 1. In a large lecture course, the scores on the final examination followed the normal curve closely. The average score was 60 points and three fourths of the class scored between 50 and 70 points. The SD of the scores was
 - (i) larger than 10 points
 - (ii) smaller than 10 points
 - (iii) impossible to say with information given

Explain your answer.

2. Find the correlation coefficient for the data set below.

x	y
4	4
4	2
3	1
3	5
1	5
3	7

3. Pearson and Lee obtained the following results for about 1,000 men:

average height ≈ 69 inches, SD ≈ 2.5 inches,

 $r \approx 0.8,$

average forearm length ≈ 18 inches, SD ≈ 1 inch.

The scatter diagram is football-shaped.

Of the men who were 6 feet tall (to the nearest inch), about what percentage had forearms shorter than 18 inches?

4. For the 988 men age 18–24 in the HANES sample

average height ≈ 70 inches SD ≈ 3 inches average weight ≈ 162 pounds SD ≈ 30 pounds correlation ≈ 0.47

One man in the sample was 63 inches tall and weighed 135 pounds. In comparison with the other men in the sample of the same height, this man would be

(i) a little light (ii) a little heavy

Circle one option and explain your choice.

- 5. Bartholemew will draw one hundred and sixty tickets at random with replacement from the box 0 0 0 1 2. Estimate the chance that 1 turns up on exactly 32 draws. Show your work. Please round your answer to the nearest whole percent.
- 6. A survey research center conducts frequent opinion polls, using large samples drawn by probability methods which are practically free from bias. Each of the last 100 polls was carried out to estimate a percentage. All the standard errors were computed by the appropriate technique, and turned out to be very close to 3 percentage points. About how many of the estimates were off by more than 3 percentage points?
- One event has chance 1/2, another has chance 1/3. Fill in the blanks, using one phrase from each pair below, to make up two true sentences. Write out *both* sentences.

"If you want to find the chance that <u>(i)</u> will happen, check to see if they are <u>(ii)</u>; if so, you can <u>(iii)</u> the chances."

- (i) at least one of the two events, both events
- (ii) independent, mutually exclusive
- (iii) add, multiply

(In this problem, no work need be shown.)

- 8. The speed of light is measured 25 times by a new procedure. The 25 measurements are recorded, and show no trend or pattern. The investigators work out the average and SD of the 25 numbers; the average is 299,789.2 kilometers per second and the SD is 12 kilometers per second.
 - (a) Find an approximate 95%-confidence interval for the speed of light, showing your work. (You may assume the Gauss model, with no bias.)
 - (b) Now the investigators measure the speed of light a 26th time by the same procedure, and get 299,781 kilometers per second. Is this a surprising result?

Yes _____ No ____

Check one, and give your reason.

- 9. There are about 2,700 institutions of higher learning in the United States (including junior colleges and community colleges). In 1976, as part of a continuing study of higher education, the Carnegie Commission took a simple random sample of 225 of these institutions. The average enrollment in the 225 sample schools was 3,700, with an SD of 6,000. A histogram for the enrollments was plotted and did not follow the normal curve. However, the average enrollment of all the 2,700 institutions was estimated to be around 3,700, give or take 400 or so. Say whether each of the following statements is true or false, and explain why.
 - (a) It is estimated that 95% of the institutions of higher learning in the United States enroll between 3,700 - 800 = 2,900 and 3,700 + 800 = 4,500 students.
 - (b) An approximate 95%-confidence interval for the average enrollment of all 2,700 institutions runs from 2,900 to 4,500.
 - (c) If someone takes a simple random sample of 225 institutions of higher learning, and goes two SEs either way from the average enrollment of the 225 sample schools, there is about a 95% chance that this interval will cover the average enrollment of all 2,700 schools.
 - (d) The normal curve can't be used to figure confidence levels here at all, because the data don't follow the normal curve.
- 10. A surveyor is measuring the distance between five points A, B, C, D, and E. They are all on a straight line. He finds that each of the four distances AB, BC, CD, and DE measures one mile, give or take an inch or so. These four measurements are made independently, by the same procedure.



The distance from A to E is about four miles, give or take around

4 inches 2 inches 1 inch $\frac{1}{2}$ inch $\frac{1}{4}$ inch.

Explain briefly. (You may assume the Gauss model, with no bias.)

- 11. A certain town has 25,000 families. The average number of children per family is 2.6, with an SD of 0.80. The distribution is not normal, however, since 20% of the families have no children at all.
 - (a) If one draws a simple random sample of five families from the 25,000, what is the chance that exactly two of the five sample families will have no children?
 - (b) If one draws a simple random sample of 900 families from the 25,000, what is the chance (approximately) that somewhere between 18% and 22% of the sample families will have no children? (Any correction factors may be ignored.)
- 12. A large number of measurements on a standard kilogram have established that our weighing procedure gives an average which is 500 micrograms too high, with an SD of 10 micrograms. We have just been sent a new checkweight, which we have been asked to weigh. The owners of this checkweight specify that they wish the weight we report to be accurate to within 1 microgram. We reply that we can't guarantee that, but that we are prepared to guarantee that our answer to similar requests will be accurate to within 1 microgram 95% of the time.

How many measurements do we need to take?

13. (a) One day, upon tossing a single die 180 times, I got:

32 ones, 28 twos, 35 threes, 36 fours, 29 fives, and 20 sixes.

Compute χ^2 and find P for this experiment.

(b) Another day, upon tossing the same single die 120 times, I got:

12 ones, 26 twos, 20 threes, 21 fours, 15 fives, and 26 sixes.

Compute χ^2 and find P for this experiment.

- (c) Now, compute the pooled χ² using the combined degrees of freedom, and find the pooled *P*-value.
 Is the die biased, based on the combined evidence?
- (d) Give the details of an alternate method of setting up a χ^2 -test on the combined data. (Just indicate the steps in the procedure—do not perform the computations.)

14. A study was done in 1962 showing that among all 3,600 seniors graduating from public high schools in the city of Rochester, New York, the average number of state capitals a student could name correctly was 17.1.

In 1990 a simple random sample of 169 seniors graduating from public high schools in Rochester, New York, showed that the average number of state capitals that a student in the sample could name correctly was 16.3 with an SD of 7.8.

Does this show that the average number all graduating seniors could name correctly has gone down? Or can the difference be explained as a chance variation? Formulate the null and alternative hypotheses before deciding.